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value given in (8), and, instead of ρ_0, that given in (5). We then obtain

$$(11)\quad \alpha-\alpha_0=\alpha_0\left(0{\cdot}000000196h+0{\cdot}00265\cos 2\phi+\tfrac{3}{8}\frac{\pi_0-6}{760}\right)$$

We have for

Greenwich $\alpha_0 = 60''{\cdot}156$ (mean), $h = 47^{\text{m}}$, $2\phi = 102^\circ\ 57'$
Pulkowa „ $= 60{\cdot}164$ „ „ $= 75$, „ $= 119\ 33$

Hence, if first we neglect the member depending on π_0,

Greenwich ... ... $\alpha-\alpha_0 = -0''{\cdot}035$
Pulkowa ... ... „ $= -0{\cdot}078$

Therefore we obtain for *the value of the constant of refraction reduced to the density* $\rho_0 = 1-\frac{3}{8}\,\frac{6}{760}$, *and hence to* $h = 0$, $\phi = 45^\circ$, $B = 760$ mm., $\tau = t = 0^\circ$ C., $\pi = 6$ mm.

Greenwich ... ... $60''{\cdot}121 + 0''{\cdot}030(\pi_0-6)$
Pulkowa ... ... $60{\cdot}086 + 0{\cdot}030(\pi_0-6)$
Munich ... ... $60{\cdot}104$
Heidelberg ... ... $60{\cdot}161$

If the observations were equally distributed over the whole year we might accept for π_0 the mean from the monthly means of the vapour pressure of Greenwich and Pulkowa respectively, but this assumption on the distribution of the observations is not permissible. However, even if π_0 were known, the correction depending on π_0 would be uncertain, for it is possible that in the expression for the correction mentioned $\frac{1}{8}$ has to be put in the place of $\frac{3}{8}$ (*Monthly Notices*, 1905 June).

Vienna-Ottakring : 1905 *November* 13.

Note on an Experiment on Lateral Refraction.
By B. F. E. Keeling, Survey Department, Egypt.

(*Communicated by Professor H. H. Turner.*)

A geodetic triangulation is about to be made by the Egyptian Survey Department with the object of linking up the South African survey along the 30° E. meridian and the Russian triangulation. The first question which was raised was the position of the chain, whether to utilise in the main the Nile Valley or to take the chain wholly to east or west of it. From the point of view of convenience and economy the former is evidently to be preferred, but it was asked whether it would not

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militate against accuracy to have a large number of sights with their end sections over the desert and the middle sections over the cultivated Nile Valley. It was feared that there might be considerable differences in the apparent lines of sight between day and night, and it was with the object of testing the stability of the apparent line joining two stations that this experiment was undertaken.

The experiment was on the lines of that by C. M. v. Bauernfeind,* but instead of four only two signals were observed. The theodolite used was a 40-centimetre one made by Brünner in (about) 1860, and readjusted recently by Cooke & Sons. It has an object-glass 60 mm. in diameter and of about 750 mm. focal length. The eyepiece micrometer reads directly to seconds. The theodolite was mounted on a brick pier isolated from the floor in one of the buildings of Helwan Observatory, about 100 metres above the Nile. The first signal was about 600 metres distant, and consisted of a metal plate mounted in a brick wall. In the plate was a hole one centimetre in diameter which was illuminated from behind by a heliograph during the day and a bicycle lamp at night. Between the theodolite and this mark was a small ravine 10 to 30 metres deep. The distant station was situated on the other side of the Nile Valley on a low hill near the pyramids of Giza, and was also some 100 metres above the Nile. It was about 25 kilometres from the theodolite.

A 5-in. heliograph was used by day and a powerful motor lamp at night, both being self-centring on a brass support cemented into a brick pillar.

The line of sight crossed about 7 kilometres of desert at each end with 11 kilometres of cultivation in the middle. The two signals were nearly in the same straight line as seen from the theodolite, the angle between them being about 10′. The measures were made entirely with the eyepiece micrometer, the two signals being successively brought into the field of view by the slow motion of the vertical circle.

Two series of observations were made. The first was spread over five days in April 1905. The work was a good deal interrupted by a sand storm which was blowing for a great part of the time. The maximum and minimum temperatures are given for each day, and it will be seen that the range was large and the temperatures high.

The second series was made in December 1905. The weather was for the most part clear, with mists which interrupted the observations in the early morning. Both the temperatures and the daily range were very much lower than in the former experiment, whilst the humidity was higher. The effective width of cultivation was greater, as the flood-water had only just been drawn off the land, and the whole of the 11 kilometres was wet.

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* *Ergebnisse aus Beobachtungen der terrestrischen Refraktion.* München, Akad. Abhandl., xiii., 1880.

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The tables which follow give the results of the observations. No accurate determination of the value of the micrometer was made in either case, so the two series are not comparable with each other as regards absolute values.

The calculated error of a single observation considered by itself was from ±0·1 to ±0·3 of a division.

It does not appear that there is any regular diurnal swing of the line of sight, and indeed the divergence of any observation from the mean is so little greater than the calculated probable error of the observation that the experiments, so far as they go, show that if observations are spread over a few days the Nile Valley will not be unfavourable to triangulation. The line of sight was intentionally lower than will usually be the case in the actual triangulation.

Incidentally some information can be gleaned as to the hours of work available, though of course the number of days over which the work extended was small. The light from the heliograph was always in vibration; its apparent diameter was often as much as 60 in., and often numerous sparks were shot off in all directions. But still the observations seem to show that it is only rarely that work need be discontinued, and, moreover, that the morning observations and condition of the atmosphere were not greatly inferior to those in the evening.

Table I.

Date.	Time.	Observed Angle 3^{t}+divs.	Mean−Observed E.	Temp. ° C.	Relative Humidity. %	—	Temp. Max. ° C.	Temp. Min. ° C.	Humidity %. 8 am.
18 4 05	7 p.m.	19·6	−0·4	30	4		...	...	...
	9 p.m.	19·5	−0·5	26	10	Helwan	37	14	49
	11 p.m.	20·2	+0·2	25	8	Giza *	36	11	60
19 4 05	6 a.m.	20·6	+0·6	20	16				
	7 a.m.	20·8	+0·8	25	14				
	7 p.m.	20·5	+0·5	36	4	Helwan	39	18	21
	9 p.m.	20·5	+0·5	26	31	Giza *	39	14	53
20 4 05	1 a.m.	19·4	−0·6	20	40				
	7 a.m.	21·0	+1·0	24	13				
	9 a.m.	19·4	−0·6	27	33				
	11 a.m.	20·4	+0·4	35	9	Helwan	41	16	35
21 4 05	7 p.m.	19·5	−0·5	37	11	Giza *	36	15	65
	9 p.m.	19·5	−0·5	33	10				
	11 p.m.	19·2	−0·8	33	7	Helwan	42	21	24
22 4 05	3 a.m.	19·7	−0·3	29	8	Giza *	41	14	56
	5 a.m.	19·9	−0·1	27	11				
	7 a.m.	20·4	+0·4	27	14				
	9 a.m.	20·3	+0·3	34	7	Helwan	42	26	6
	7 p.m.	20·5	+0·5	37	7	Giza *	41	24	21
	9 p.m.	19·6	−0·4	20	15				
Mean		20·02							

1 div. = 1 sec. nearly.

* Meteorological station in the cultivation.

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Table II.

Date.	Time.	Observed Angle 3t+divs.	Mean—Observed Divs.	Temp. 0° C.	Relative Humidity. %	—	Temp.		Humidity %. 8 a.m.
							Max. ° C.	Min. ° C.	
4 12 05	10 a.m.	19·7	−0·7	18	38				
	2 p.m.	20·9	+0·5	21	35				
	6 p.m.	20·0	−0·4	17	38	Helwan	22	10	63
	8 p.m.	20·0	−0·4	15	54	Giza	24	8	79
	Midn.	19·9	−0·5	12	46				
5 12 05	2 a.m.	20·2	−0·2	12	51				
	10 a.m.	20·4	±0·0	16	46				
	Noon	20·7	+0·3	20	36				
	2 p.m.	20·8	+0·4	21	32	Helwan	22	10	51
	4 p.m.	20·4	±0·0	21	25	Giza	25	8	66
	6 p.m.	21·0	+0·6	18	43				
	8 p.m.	20·9	+0·5	16	46				
6 12 05	8 a.m.	20·6	+0·2	12	59				
	10 a.m.	20·5	+0·1	17	50				
	Noon	21·6	+1·2	19	42				
	2 p.m.	20·8	+0·4	22	36	Helwan	22	9	58
	4 p.m.	20·4	±0·0	21	42	Giza	23	9	69
	6 p.m.	19·5	−0·9	19	54				
	10 p.m.	20·6	+0·2	16	68				
7 12 05	10 a.m.	21·1	+0·7	20	59				
	Noon	20·6	+0·2	22	42				
	2 p.m.	20·6	+0·2	23	39				
	4 p.m.	19·4	−1·0	22	43	Helwan	24	14	76
	6 p.m.	20·6	+0·2	20	48	Giza	26	9	100
	8 p.m.	20·8	+0·4	18	59				
	Midn.	20·7	+0·3	17	72				
8 12 05	10 a.m.	19·8	−0·6	20	61				
	Noon	20·1	−0·3	23	43				
	2 p.m.	19·8	−0·6	23	40	Helwan	23	14	74
	4 p.m.	20·5	+0·1	22	50	Giza	24	11	88
	8 p.m.	20·6	+0·2	18	72				
	Mean	20·4							

1 div. = 1 sec. nearly.

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